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An Evaluation of Patient Usage of Computers to Manage Information Relevant to Diabetes Care

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Abstract
The use of computer technology has been shown to be of benefit in the task of diabetes care, however, the use of available systems is not widespread. An online survey was used to gather the views of potential users. The results showed that many of the respondents were aware of the benefits of electronic data management, and a number are actually taking advantage of it.

Keywords: Diabetes, Computers, Self-Monitoring of Blood Glucose

1. Introduction

Lehmann and Deutsch [1] have stated that diabetes care is potentially a data-rich field, but in practice little of the data is used. Research into the use of computers to assist the management of diabetes has been going on for a number of years. Several systems have been developed which have been shown to improve outcomes of diabetes control by lowering HbA1c levels, decreasing the frequency of hypoglycaemic events, and lowering daily insulin requirements [2, 3, 4].

Lehmann and Deutsch [5] consider that without information technology, it will not be possible to deliver the benefits of intensive insulin therapy to a wide population. It has also been stated that while the cost of developing the required systems will be high, the long term savings will outweigh the initial expenditure [6]. However, the acceptance and use of such systems in the real world is still very limited [7]. Albisser et al [8] stated that the proportion of health care professionals who work well with Information Technology (IT) is not large, and Laerum et al [9] found that where systems had been implemented, a large proportion of the functions provided by the systems were not used.

These issues of lack of acceptance may have been becoming less of a limiting factor during the past decade, as the use of IT in medicine has become more widespread. Bellazzi [10] and Joshy and Simmons [11] consider that recent advances are starting make the use of the technology effective.

This paper investigates the current use of such technology for the management of diabetes and attempts to understand what factors are preventing the use of the technology becoming widespread.

2. Methods

An online questionnaire was constructed to gather information about attitudes towards, and the use of, Information Technology and data management in diabetes. An online questionnaire was chosen as it would be able to potentially reach a large audience. The Data Collection Form is shown in Figure 1 - Data Collection Form1 - Data Collection Form.

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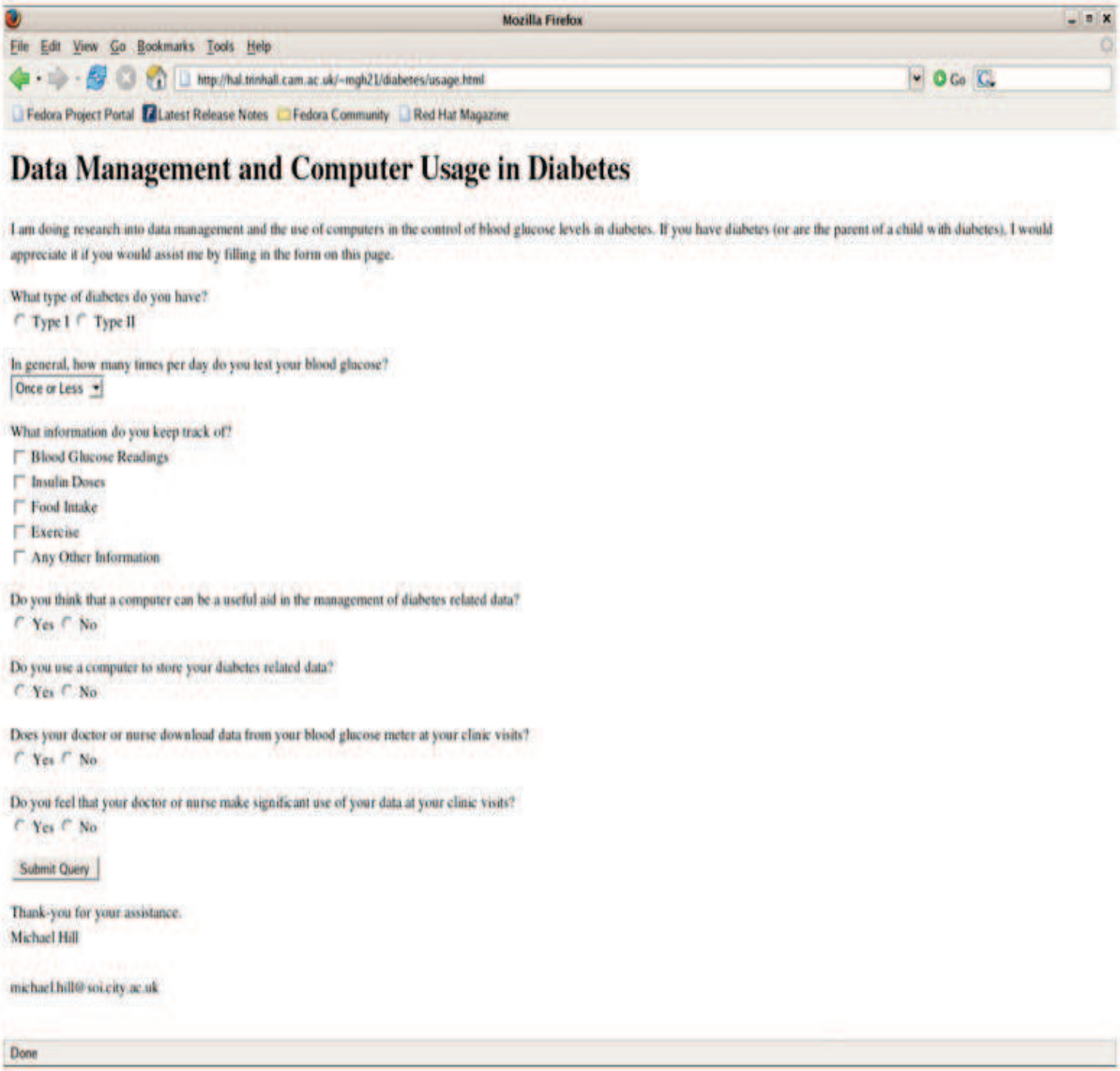
Mozilla Firefox
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http://hal.trinhall.cam.ac.uk/~mgh21/diabetes/usage.html
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Latest Release Notes
Fedora Community
Red Hat Magazine
Data Management and Computer Usage in Diabetes
I am doing research into data management and the use of computers in the control of blood glucose levels in diabetes. If you have diabetes (or are the parent of a child with diabetes), I would appreciate it if you would assist me by filling in the form on this page.
What type of diabetes do you have?
Type I Type II
In general, how many times per day do you test your blood glucose?
Once or Less
What information do you keep track of?
Blood Glucose Readings
Insulin Doses
Food Intake
Exercise
Any Other Information
Do you think that a computer can be a useful aid in the management of diabetes related data?
Yes No
Do you use a computer to store your diabetes related data?
Yes No
Does your doctor or nurse download data from your blood glucose meter at your clinic visits?
Yes No
Do you feel that your doctor or nurse make significant use of your data at your clinic visits?
Yes No
Submit Query
Thank-you for your assistance.
Michael Hill
michael.hill@soi.city.ac.uk
Done

Figure 1: *Data collection form.*

The form contained a number of questions asking for information about:

- The type of diabetes: Insulin Dependent Diabetes Mellitus (IDDM)/Type 1, or, Non Insulin Dependent Diabetes Mellitus (NIDDM)/Type 2;
- the frequency of blood test measurements per day;
- the types of data items which are recorded; and
- a specific set of four questions relating to data management.

This is shown in Figure 2- Information requested in the Data Collection Form2- Information requested in the Data Collection Form.

The questionnaire was kept short and simple thus making it quick and easy to complete, thereby increasing the appeal to potential respondents. The questions were chosen to get a quick overview of how widespread usage was, and an idea of attitudes towards this type of technology application.

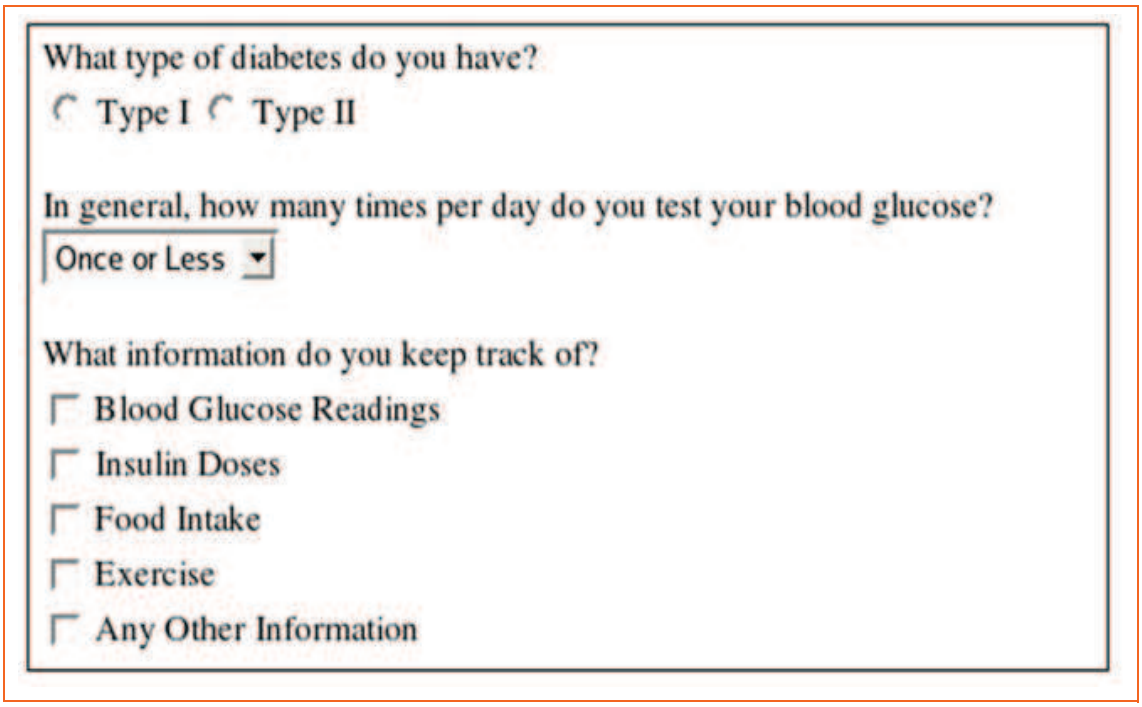
What type of diabetes do you have?
Type I
Type II
In general, how many times per day do you test your blood glucose?
Once or Less
What information do you keep track of?
Blood Glucose Readings
Insulin Doses
Food Intake
Exercise
Any Other Information

Figure 2: *Information requested in the data collection form.*

The data management questions asked the respondents:

- if they thought IT could be useful in the management of diabetes;
- if they used a computer for storing diabetes related data;
- if their doctor or clinic downloaded the readings from their blood testing machine; and
- their opinion on whether their doctor or clinic made significant use of the data they presented at their appointments.

These are shown in Figure 3- Data Management Questions in the Data Collection Form3- Data Management Questions in the Data Collection Form.

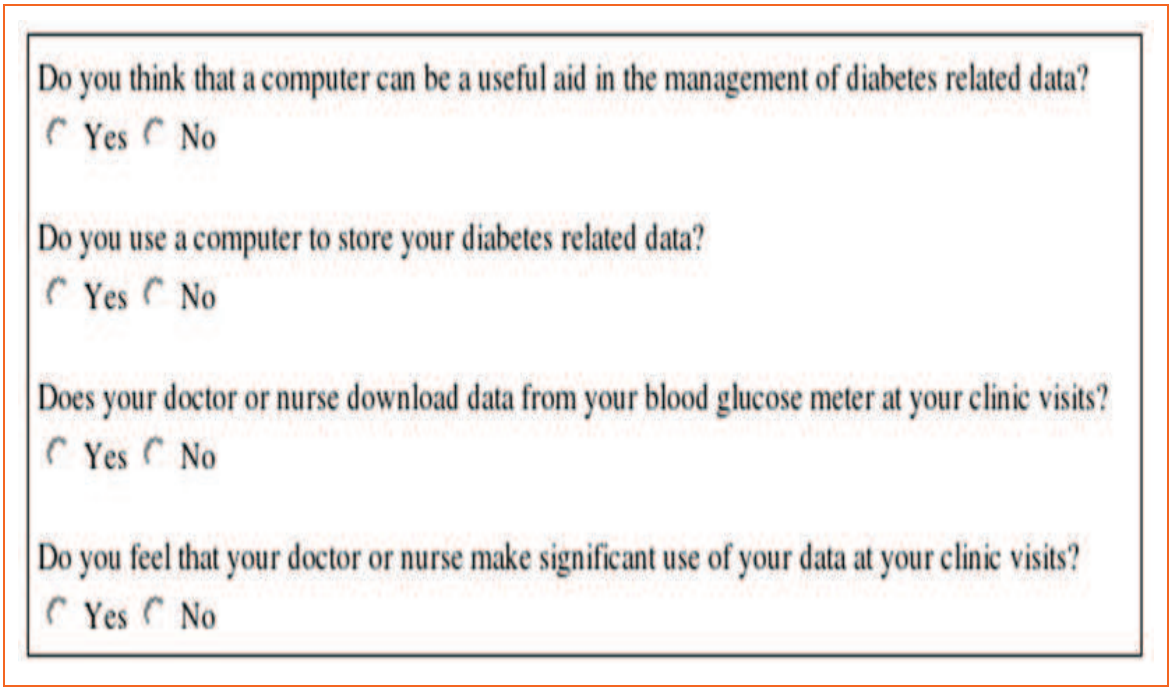
Do you think that a computer can be a useful aid in the management of diabetes related data?
Yes
No
Do you use a computer to store your diabetes related data?
Yes
No
Does your doctor or nurse download data from your blood glucose meter at your clinic visits?
Yes
No
Do you feel that your doctor or nurse make significant use of your data at your clinic visits?
Yes
No

Figure 3: *Data management questions in the data collection form.*

The locations of respondents were determined from the IP address of the computer from which the site was accessed, using GeoIP (MaxMind LLC, MA) running on OpenBSD.

The data collection site was publicised by contacting various diabetes-related organisations and asking them to assist by advertising the questionnaire and associated WebPages:

- The Diabetes Research and Wellness Foundation (DRWF) of the United Kingdom included a notice in their newsletter;
- The Huntingdonshire Diabetes Voluntary Support Group (HDVSG) included a notice in their newsletter;
- A message was submitted to the insulin pumpers forum (www.insulin-pumpers.org) mailing list by Pat Reynolds;
- David Mendosa, who runs a diabetes information website (www.mendosa.com) also included a notice in his newsletter;
- Diabetes UK responded to the query but declined to provide any assistance; and finally
- DRWF(USA), Diabetes Australia, Diabetes WA and Diabetes NZ failed to respond to requests for assistance.

The first two newsletters mentioned above, (DRWF and HDVSG) were paper newsletters mailed out to members, thus ensuring potential respondents were not limited to those accessing on-line sites and web pages, but would also be available to people that only occasionally use computers and rather read paper newsletters about diabetes.

The pages could also be accessed via links from the departmental pages (www.soi.city.ac.uk) and via the usual Internet search engines.

3. Results

The data collection pages were live for a period of 12 months, from July 2006 to July 2007. At the end of this time, a total of 73 responses had been collected.

3.1. Location of Respondents

The respondents were located mainly in the UK and USA, with the other replies widely scattered. The wide geographical spread of the respondents shows that the attempts to publicise the site were in some way successful.

Figure 4- Location of Respondents4- Location of Respondents, shows the list of countries where the respondents were located.

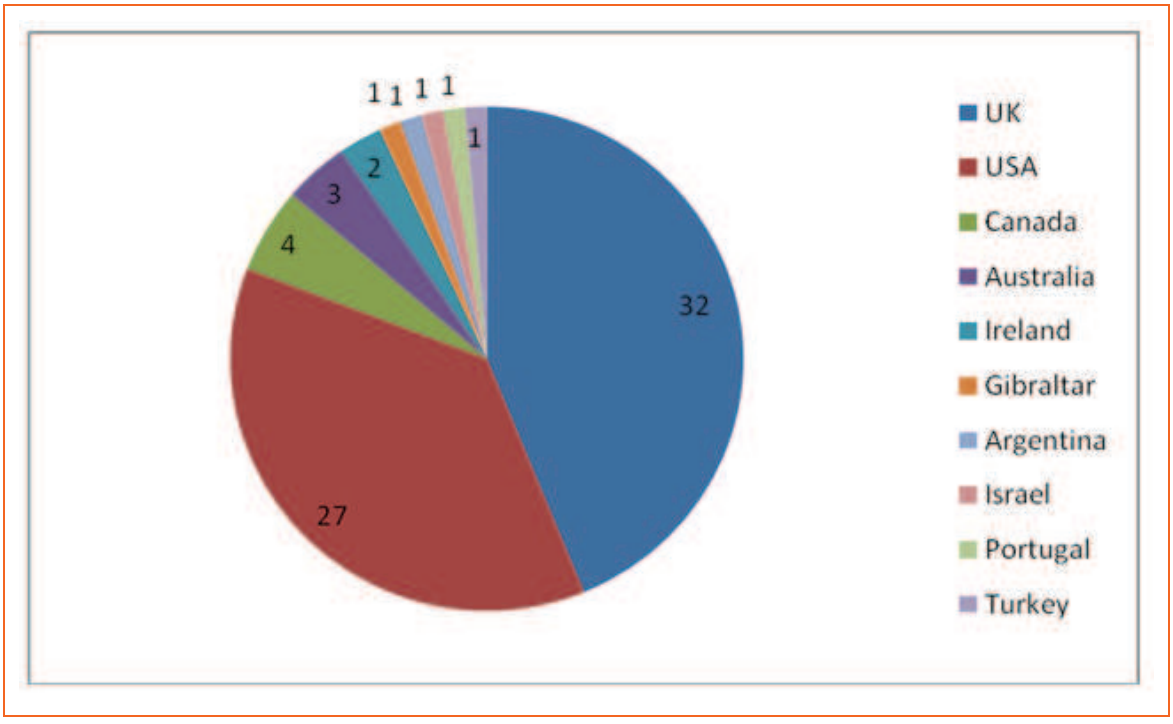

Figure 4: *Location of respondents.*

While patients with IDDM make up around 15% of the total diabetes population, they were the majority of the respondents at almost 60%, as shown in 1: Category of Respondents. This may be due to a higher level of motivation amongst these patients.

Type	Number	Percentage
Respondents with Type 1 Diabetes	43	58.90%
Respondents with Type 2 Diabetes	30	41.10%
Total Number of Respondents	**73**	

Table 1: *Category of respondents.*

3.1.1. Blood Testing Frequency per Day

Table 2: shows the number of blood tests performed by the respondents per day.

Frequency per Day	No	Percentage
1 or less	15	20.55%
2	9	12.33%
3	6	8.22%
4 or more	43	58.90%

Table 2: *Blood test frequency per day for all respondents.*

Table 3: shows the number of blood tests performed by the respondents, further classified by diabetes type.

Tests per Day	Type 1 No	Type 1 %	Type 2 No	Type 2 %
1 or less	1	2.33%	14	46.67%
2	4	9.30%	5	16.67%
3	3	6.98%	3	10.00%
4 or more	35	81.40%	8	26.67%

Table 3: *Blood tests per day (Type 1 and Type 2)*

3.2. Data Items Recorded by Respondents

Table 4: Data items which are recorded.4: Data Items Which are Recorded, shows the number of respondents that regularly recorded information, other than blood test results, and the types of information recorded.

Data Item Recorded	Number	Percentage
Blood Glucose Readings	69	94.52%
Insulin Doses	43	58.90%
Food Intake	31	42.47%
Exercise	23	31.51%
Other	21	28.77%

Table 4: *Data items which are recorded.*

3.3. Data Management Questions

Table 5: shows the responses of the respondents to the 4 questions asked in the data collection web pages.

Question	Number	Percentage
Those who think that IT can be a useful aid in Diabetes Management	71	97.26%
Those who do use a computer to store diabetes related data	42	57.53%
Patients whose clinics download BG meter data	11	15.07%
Patients who think that their clinic makes significant use of their data	34	46.58%

Table 5: *Responses to questions.*

It can be seen that most realise the usefulness of IT, as, only two out of 73 stated that they did not think that computers could be useful in the management of diabetes.

4.Discussion

This sample size is fairly small, and made up of patients who are likely to be well motivated, as they would have been reading publications about diabetes, or using online resources to become aware of the questionnaire, and have made the extra effort to follow up and visit the site. As Internet users, they will also be a computer literate group. Thus, this is a very select sample.

There is less consensus on the benefits of Self Monitored Blood Glucose (SMBG), for Type 2 patients, and therefore these patients are not encouraged to use it as much. Thus, as expected, those with type 2 diabetes test their blood glucose less frequently than those with type 1, [12] .

While nearly all those that responded felt that computers could be useful to them in this task, almost all keep records of blood glucose readings, most keep records of insulin doses, and a large number record other data (see Table 5) only 57% actually made use of a computer to store their data. This implies that the information is kept in a paper record. Keeping the data in this format instead of on a computer limits the interpretation and evaluation that can be done with it. Strowig and Ruskin [13] consider that computer generated analysis of blood glucose readings can make data more meaningful, easier to organise and evaluate, and improve the ability of the patient and health care provider to discuss the results.

Blood glucose meters which are able to store a large number of readings along with date and time information are a great asset to record keeping. The ability to connect them to a computer and download the readings is a feature which eliminates data entry errors, and makes manipulation and processing of the information easy. This is something that is being little used by doctors and clinics. Only 11 out of the 73 respondents reported the use of this feature.

According to Bailey [14], less than 25% of practioners who specialize in treating diabetes, download data from patient's blood glucose meters. Further the incompatibility of the connecting cables and proprietary software are the main factors preventing blood glucose downloads in clinics. Other factors of consideration are the time required to connect the devices, time to transfer the data and process

it, and the lack of reimbursement for any such data analysis tasks by health insurers.

The results presented in this paper are thus comparable with other studies, and whilst the results may not be novel, they have been collected using different methods and attracted responses from an international group of respondents giving the results a different perspective.

Patients are encouraged to keep accurate records of treatment related information, especially blood glucose readings. These reports should be taken to the clinic to support any decisions to change therapy. Less than half of the respondents felt that significant use was being made of the data they presented at their clinic visits.

5.Conclusion

Both Type 1 and Type 2 diabetes patients do make an effort to record information about their diabetes, but by not storing it electronically many potential uses of it are lost.

Computer systems have been shown to be useful in the management of diabetes. The results of this survey show that the potential of this type of technology continues to be very under exploited, despite the more widespread acceptance of, and expanding usage of Information Technology in many daily activities.

Almost all surveyed considered that IT could be a useful aid in Diabetes Management thus implying that a lack of confidence in the technology itself is not a significant factor in the actual lack of usage of the data collected.

Why such a large proportion of those who believe it can be of use do not actually then follow through and use it is an issue that needs to be looked into further.

Further studies could also concentrate on gathering more comprehensive information from respondents, such as age groups, to see if these influence factors related to data management, and could also attempt to establish if respondents feel that their health carers encourage the electronic collection of such information and are making good use of it.

Acknowledgements

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4. References

1. Lehmann ED, Deutsch T. Computer assisted diabetes care: a 6-year retrospective. Computer Methods and Programs in Biomedicine. 1996; 50: 209-230.

2. Schiffrin A, Mihic M, Leibel BS, Albisser AM. Computer Assisted Insulin Dosage Adjustment. Diabetes Care. 1985 Nov-Dec; 8(6):545-52.

3. Albisser AM, Wright CE, Sakkal S. Averting Iatrogenic Hypoglycaemia through Glucose Predictions in Clinical Practice: Progress towards a New Procedure in Diabetes. Diabetes Research and Clinical Practice. 2007; 76(2):207-14.

4. Cavan DA, Hejlesen OK, Hovorka R, Evans JA, Metcalfe JA, Cavan ML, Halin M, Andreassen S, Carson ER, Sönksen PH. Preliminary experience of the DIAS computer model in providing insulin dose advise to patients with insulin dependent diabetes. Computer Methods and Programs in Biomedicine. 1998; 56(2):157 - 164.

5. Lehmann ED, Deutsch T. Compartmental Models for Glycaemic Prediction and Decision Support in Clinical Diabetes Care: Promise and Reality. Computer Methods and Programs in Biomedicine. 1998; 56(2):193-204.

6. Lehmann ED. Application of computers in clinical diabetes care. Diab Nutr Metab. 1997; 10:45-59.

7. Montani S, Bellazzi R, Quaglini S, d'Annunzio G. Meta-Analysis of the Effect of the Use of Computer-Based Systems on the Metabolic Control of Patients with Diabetes Mellitus. Diabetes Technology and Therapeutics. 2001; 3(3): 347-356.

8. Albisser AM, Harris RI, Sakkal S, Parson ID, Chao SC. Diabetes Intervention in the Information Age. Medical Informatics. 1996; 21(4):297-316.

9. Laerum H, Ellingsen G, Faxvaag A. Doctors use of electronic medical record systems in hospitals: A cross sectional survey. British Medical Journal. 2001; 323:1344-1348.

10. Bellazzi R. Electronic Management Systems in Diabetes Mellitus: Impact on Patient outcomes. Disease Management and Health Outcomes. 2003; 11(3): 159-171.

11. Joshy G, Simmons D. Diabetes Information Systems: A Rapidly Emerging Support for Diabetes Surveillance and Care. Diabetes Technology and Therapeutics. 2006; 8(5):587-597.

12. Montagnana M, Caputo M, Giavarina D, Lippi G. Overview on self-monitoring of blood glucose. Clinica Chimica Acta. 2009; 402(1-2):7-13.

13. Strowig SM, Raskin P. Improved Glycemic Control in Intensively Treated Type 1 Diabetes Patients Using Blood Glucose Meters with Storage Capability and Computer Analysis. Diabetes Care. 1998; 21(10):1694-1698.

14. Bailey, TS. Diabetes Data Management in the Clinic. Journal of Diabetes Science and Technology. 2007; 1(6):888-891.

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